"Express Mail" mailing label number
EL 064848973 US

Date of Deposit March 26, 2002

JC10 Rec'd PCT/PTO 26 MAR 2002

FORM PTO-1390 (REV. 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		CASE NO. 742/226
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (Known per 37 CFR 1.5) 10/089415
INTERNATIONAL APPLICATION NO. PCT/US00/02541	INTERNATIONAL FILING DATE February 1, 2000	PRIORITY DATE CLAIMED February 19, 1999

TITLE OF INVENTION
METHOD AND APPARATUS FOR REGISTERING A TORQUE-TRANSMITTING TOOL IN A FIXTURE AND FOR FORMING A DIAGONAL BORE IN THE TOOL

APPLICANT(S) FOR DO/EO/US
George F. Charvat

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☒ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)) and/or amendments under Article 34.

Items 11. to 16. Below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: Copy of Response to Written Opinion of March 5, 2001

JC10 Rec'd PCT/PTO 26 MAR 2002

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 10/089415	INTERNATIONAL APPLICATION NO. PCT/US00/02541	CASE NO. 742/226	
		CALCULATIONS	PTO USE ONLY

17. ☒ The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO	$890.00
International preliminary **examination** fee paid to USPTO (37 CFR 1.492(a)(1))	$710.00
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international **search** fee paid to USPTO (37 CFR 1.492(a)(2))	$740.00
Neither international preliminary **examination** fee (37 CFR 1.482) nor international search fee (37 CFR 1.492(a)(3)) paid to USPTO	$1,040.00
International preliminary examination **fee** paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT				$710.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).					
Claims	Number Filed	Number Extra	Rate		
Total Claims	39 - 20 =	19	x $ 18.00	$342.00	
Independent Claims	8 - 3 =	5	x $ 84.00	$420.00	
Multiple dependent claim(s) if Applicable)		0	+ $280.00	$280.00	
			TOTAL OF ABOVE CALCUATIONS =	$1,752.00	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)					
			SUBTOTAL =	$876.00	
Surcharge of $130.00 for furnishing the English translation later than the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
			TOTAL NATIONAL FEE=	$876.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +					
			TOTAL FEES ENCLOSED=	$876.00	
				Amount to be refunded	$
				charged	$

a. ☒ A check in the amount of $876.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 23-1925 in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-1925. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send All Correspondence to:
Brinks Hofer Gilson & Lione
P.O. Box 10395
Chicago, IL 60610

Signature
Joseph F. Hetz
Name
41,070
Registration Number

Rev. Oct-01
C:\Doc\742 - JODA Enterprises, Inc\PCT Filings\742-226 PCT.doc

6/PRTS

Method and Apparatus for Registering a Torque-Transmitting Tool in a Fixture and for Forming a Diagonal Bore in the Tool

BACKGROUND

The present invention relates to machining and registering methods well suited for use with torque-transmitting tools such as out-of-round drive studs.

U. S. Patent No. 5,644,958, assigned to the assignee of the present invention, discloses a quick release mechanism for an extension bar suitable for use with a socket wrench. This quick release mechanism utilizes a diagonally-oriented, stepped bore formed in the drive stud of the extension bar.

The machining of such diagonal bores presents manufacturing difficulties. In particular, there is a need to register the drive stud reliably with respect to the drilling axis. Poor registration can result in misplaced machined surfaces, and is therefore to be avoided. Proper location of a diagonal bore is even more difficult, because the oblique orientation of such a bore can cause the bore to deviate from the desired drilling axis, either at the start of the bore or during the drilling operation. Furthermore, when a drill is passed completely through the drive stud on a diagonal axis, there is a tendency for the drill to break as it exits the drill stud. This tendency is especially great for a stepped bore, which requires a relatively smaller diameter portion at the front of the drill.

SUMMARY

The present invention is directed both to an improved system for registering a drive stud for machining, and to improved systems for forming a diagonal bore. The invention itself is defined by the following claims, and the

following paragraphs of this section are intended as an introduction, not as a definition of the invention.

Preferred embodiments described below efficiently form a stepped bore in a drive stud by first registering the drive stud precisely with respect to a drilling axis with a fixture that engages the shoulder between the out-of-round, extreme end portion of the drive stud and the adjacent, shank portion of the drive stud. In some preferred embodiments, the stepped bore is drilled in two stages, using two drills of differing diameters that enter the drive stud from respective sides of the longitudinal axis. The bores formed by these drills meet in the interior of the drive stud to form the required step.

Other preferred embodiments form a first seating surface on the tool at a point of intersection between an exterior surface of the tool and a drilling axis that intersects this surface at an oblique angle. This seating surface is shaped to facilitate subsequent drilling operations. For example, the seating surface may be oriented substantially transverse to the drilling axis. This feature, along with the fixture described above, can be used in methods that form the diagonal bore exclusively from one side of the longitudinal axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a plan view of a drilling system that incorporates a first preferred embodiment of this invention.

Figure 2 is a side view of the drilling system of Figure 1.

Figure 3 is an enlarged cross-sectional view showing a fixture included in the drilling system of Figures 1 and 2.

Figure 4 is a plan view of a second preferred embodiment of the drilling system of this invention.

Figure 5 is a block diagram of a method practiced by the drilling system of Figure 4.

Figures 6, 7 and 8 are partial cross-sectional views showing three stages in the formation of a diagonal bore.

Figure 9 is a block diagram of a method of another embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now Figures 1 and 2, a drilling system 10 incorporates a preferred embodiment of this invention. The drilling system 10 includes a table 12 that supports first and second drilling heads 14, 16, a fixture 18, and a clamp 20. The first and second drilling heads 14, 16 support first and second drills 22, 24 aligned with respective first and second drilling axes 26, 28. The first and second drilling heads 14, 16 are rotated in the conventional manner about the respective drilling axes 26, 28 by motors (not shown) and are moved axially along the respective drilling axes 26, 28 by respective air cylinders (not shown).

The clamp 20 supports a torque-transmitting tool T in the fixture 18 for machining.

Figure 3 shows a cross-sectional view of the fixture 18 with the tool T clamped in place. As shown in Figure 3, the tool T includes a drive stud that is made up of a shank portion S and an out-of-round drive portion D. In this embodiment, the shank portion S has a circular cross-section and the drive portion D has substantially a square cross-section. The transition between the shank S and the drive portion D comprises a shoulder R that defines a reference point at any desired point on the shoulder R.

The fixture 18 defines an out-of-round opening 30 that is shaped to receive the drive portion D, and a protruding element 32 that is shaped to engage the reference point on the shoulder R. Note that the opening 30 is deeper than the drive portion D is long such that the shoulder R registers the tool T with respect to the protruding element 32, and not the end of the drive portion D.

As shown in Figure 3, the fixture 18 also supports first and second drilling bushings 34, 36. Each of the bushings 34, 36 is aligned with the respective drilling axis 26, 28 and is sized to receive closely and support the respective drill 22, 24. Preferably the bushings 34, 36 are formed of a hard material such as silicon carbide, and they are provided with oblique ends 38, 40 shaped to conform closely to the respective surfaces of the tool T and

thereby to provide support for the respective drills 22, 24 to a position closely adjacent to the tool T.

Figure 4 shows a drilling system 100 that incorporates a second preferred embodiment of this invention. The drilling system 100 is similar to the drilling system 10 in that it includes first and second drilling heads 102, 104 positioned as described above with respect to a fixture 106. The drilling heads 102, 104 and the fixture 106 can be identical to the drilling heads 14, 16 and the fixture 18 described above.

In addition, the drilling system 100 includes first and second milling heads 108, 110. The first and second drilling heads 102, 104 are arranged along a first line 120, and the first and second milling heads 108, 110 are arranged along a second line 122. In this embodiment, the lines 120, 122 intersect at an angle of about 60°.

The fixture 106 and the associated clamp 112 are mounted on a plate 114 that is rotatably mounted with respect to the remainder of the system 100. The plate 114 can be rotated about the longitudinal axis L of the tool T between two positions that are separated by an angle of 180°. In the first position, the drills of the first and second drilling heads 102, 104 are aligned with the bushings 116, 118, as shown in Figure 4. In the second position (not shown), the mills of the first and second milling heads 108, 110 are aligned with the bushings 116, 118 (Figure 4).

Figure 5 provides a flow chart of a milling method practiced by the system 100 of Figure 4, and Figures 6-8 provide cross-sectional views of the tool T at three successive stages of the milling process.

In block 200 of Figure 5, the tool (an extension bar in this example) is registered in the fixture. As described above, the shoulder R between the shank S and the drive portion D is used as a reference point in order precisely to position the tool in the fixture. In block 202, first and second seating surfaces are milled on first and second surfaces of the drive stud. In Figure 6, the first and second seating surfaces are indicated at 242 and 244, respectively. As shown in Figure 6, the seating surfaces 242, 244 are formed in first and second surfaces 246, 248, respectively of the tool T. These

surfaces 246, 248 are disposed on respective sides of the longitudinal axis L, and are parallel to one another in the view of Figure 6. In this embodiment, the seating surfaces 242, 244 are formed by an end mill as planar surfaces oriented at right angles to the respective drilling axes 226, 228. After block 202 the plate 114 is indexed to bring the fixture bushings into alignment with the drilling heads.

In alternative embodiments the seating surfaces 242, 244 can be formed by machining operations along other axes, e.g. perpendicular to the surfaces 246, 248 or to the axes 226, 228. The seating surfaces 242, 244 may take many shapes. For example, they may be perpendicular to the axes 226, 228 at the point of intersection with the axes 226, 228, but otherwise curved (e.g. spherically concave or cylindrically concave), or they may form a corner that locates a drill. In all cases, the seating surfaces 242, 244 are shaped to reduce any tendency of the drill bit of a subsequent drilling operation to wander or skate away from the intended drilling axis, as compared with the original surfaces 246, 248. In some cases (e.g. the cylindrically curved or the corner surfaces described above), the seating surface will not be rotationally symmetrical about the drilling axis.

Continuing with Figure 5, in block 204 a first bore is drilled from the first seating surface into the tool, and in block 206, a second bore is drilled from the second seating surface into the tool to intersect the first bore. Figure 7 shows the tool T at an intermediate stage in the formation of the first and second bores 250, 252. Note that the first bore 250 has a larger diameter than the second bore 252, and that the respective drilling axes 226, 228 are co-linear. Figure 8 shows the tool T at a later stage of manufacture, at which the bores 250, 252 have intersected to form a stepped bore that extends completely through the tool T and defines a shoulder 254. Preferably, the first and second bores 250, 252 are drilled in a manner such that the drilling operations overlap in time to reduce the total time required to form the stepped bore. As shown in Figure 8, the angle $\alpha 1$ between the first surface 246 and the first drilling axis 26 is equal to the angle $\alpha 2$ between the second surface 248 and the second drilling axis 28. The angles $\alpha 1$ and $\alpha 2$ are both

oblique angles. If desired, either bore 250, 252 can be drilled before the other.

Continuing with Figure 5, the extension bar is then removed from the fixture in block 208.

Figure 9 relates to another preferred method of this invention. The method of Figure 9 can be used to drill a stepped bore similar to the bore shown in Figure 8, but in the method of Figure 9 all drilling and milling operations proceed from only a single side of the tool being formed.

As shown in block 300 of Figure 9, a tool is first registered in a fixture. The tool can be the tool T described above, and the fixture may be identical to the fixture shown in Figure 3. However, since all drilling operations proceed from a single side of the tool, the bushing 36 is not needed. As described above, the shoulder between the drive portion D and the shank S provides a preferred registration surface for the fixture.

Next, at 302, a seating surface is milled on an exterior surface of the tool from side S1. The seating surface may be substantially identical to the seating surface 242 of Figure 6, and the side S1 may be the surface 246 of Figure 6. At 304, the seating surface is then center drilled from side S1. A center drilling operation forms a small conical recess in the seating surface to assist in centering a drill in subsequent drilling operations.

Because the seating surface formed at 302 in this example is substantially transverse to the drilling axis of the center drill of 304, the center drill of 304 consistently and reliably forms the center drill recess at the desired intersection of the drilling axis and the seating surface. The drilling axis may be oriented as shown at 226 in Figure 6, and the center drill recess is formed at the intersection of the drilling axis 226 and the seating surface 242.

At 306, a larger diameter drill is used to drill part of the larger bore from side S1. This drill is centered by the center drill recess formed at 304. Next, at 308, a smaller diameter drill is used to form part of the smaller bore, again proceeding from side S1 along the drilling axis. At 310, the larger bore is completed from side S1 with a drill of the same diameter as that used at 306. At 312, a smaller drill is used to complete formation of the smaller bore from

side S1. The drill used at 312 is the same diameter as that used at 308. Finally, at 314, the tool is removed from the fixture. If desired, a step drill may optionally be used between blocks 312 and 314 to provide the final finish and shape to the step between the larger and smaller bores.

The method of Figure 9 can be implemented using a conventional, numerically controlled, indexed milling machine and the tool registration fixture described above. The registration fixture provides all of the advantages described in conjunction with the first and second embodiments, and the seating surface assists in properly locating the center drill recess.

It should be apparent from the foregoing discussion that the drilling systems described above precisely register the tool using the shoulder between the out-of-round drive portion and the shank portion of the drive stud. The drilling system 10 operates similarly to the drilling system 100, except that no seating surfaces 242, 244 are formed. The methods described above in conjunction with the systems 10, 100 can readily be automated in quick and reliable systems that provide little tool breakage since the drills are well-supported to a point closely adjacent the tool, and the drills are never caused to exit the tool at an oblique angle. By using the seating surfaces 242, 244, consistent results can be achieved using a preferably substantially constant speed of drill advance. The registration techniques described above may be used separately from the drilling techniques, and vice-versa.

The widest variety of machine tools and mechanisms for controlling the movement of these machine tools can be used. For example, pneumatic, hydraulic, and electric power systems can be used. Conventional numerically controlled machine tool techniques can be used to automate the methods described above. In alternative embodiments of this invention, either the machine tools can be moved along any suitable direction to bring successive machine tools into alignment with the drilling axes, or the fixture can be moved along any suitable direction to achieve a similar result. Any suitable combination of rotational and/or translational movements can be used. This invention is not limited to use with the specific machine tools or the specific workpieces described above.

As used herein, the term "drive stud" is intended broadly to encompass the out-of-round portion and adjacent portions of a torque transmitting tool at intermediate stages of manufacture.

The term "oblique" is intended broadly to encompass acute angles between 0 and 90 degrees.

The term "to machine" is intended broadly to encompass any material removal method including drilling, milling, turning, grinding and electrical discharge machining, for example.

The term "machine tool" is intended broadly to encompass any tool for machining as defined above.

The term "operative position" is intended to refer to a relative position between a machine tool and a workpiece that orients the machine tool to a desired alignment with the workpiece. The operative position can be achieved by moving either the machine tool, or the fixture in which the workpiece is registered, or both to achieve the desired alignment.

The term "machined surface" is intended broadly to encompass a surface formed by any machining activity or any machine tool, including those described above.

The term "reference surface" is intended broadly to encompass a point-like surface, a line-like surface, or a surface that extends substantially in two or three dimensions.

The term "shoulder" is intended broadly as applied to a tool to encompass any part of the transitional surface between the shank portion and the drive portion of the tool, including but not limited to portions of the transitional surface immediately adjacent to the shank portion and the drive portion.

The term "fixture" is intended broadly to encompass one or more elements that stabilize the workpiece in the desired orientation. A fixture may include multiple discrete elements that are separately mounted to a reference element, and the fixture may contact the workpiece at only a few discrete points rather than receiving the workpiece as illustrated. There is no requirement that a fixture include drill bushings as shown, whether or not drill

bushings are used. In some embodiments, the fixture may register a tool without physical contact with a reference surface of the tool, as for example when the position of the reference surface is sensed optically rather than by physical contact.

The foregoing detailed description has described only a few of the many forms that this invention can take. For this reason, this detailed description is intended only by way of illustration, and not by way of limitation. It is only the following claims, including all equivalents, that are intended to define the scope of this invention.

Claims

1. A method for registering a torque-transmitting tool comprising:

(a) providing a torque-transmitting tool comprising a shank portion, an out-of-round drive portion, and a shoulder intermediate the shank portion and the drive portion;

(b) referencing at least one machined surface of the tool drive with respect to at least one reference surface on the shoulder.

2. The method of Claim 1 wherein (b) comprises

(b1) registering the tool in a fixture that engages the reference surface on the shoulder; and

(b2) machining the at least one machined surface of the tool.

3. A method for forming a diagonal bore in a torque-transmitting tool comprising a longitudinal axis and a first surface on one side of the longitudinal axis, said method comprising:

(a) forming a seating surface on the tool at a point of intersection between the first surface and a drilling axis that intersects the first surface at an oblique angle, said seating surface oriented substantially transverse to the drilling axis at a point where the drilling axis intersects the seating surface; and

(b) drilling a bore in the tool along the drilling axis through the seating surface.

4. A method for forming a diagonal bore in a torque-transmitting tool comprising a longitudinal axis and a first surface on one side of the longitudinal axis, said method comprising:

(a) forming a seating surface on the tool at a point of intersection between the first surface and a drilling axis that intersects the first surface at an oblique angle, said seating surface being rotationally asymmetrical about the drilling axis and shaped to reduce any tendency of a

drill bit to skate in a subsequent drilling operation along the drilling axis as compared with the first surface; and

(b) drilling a bore in the tool along the drilling axis through the seating surface.

5. The method of Claim 3 or 4 further comprising:

(c) center drilling the seating surface along the drilling axis after (a) and before (c).

6. A method for forming a diagonal bore in a torque-transmitting tool comprising a longitudinal axis and first and second surfaces on different sides of the longitudinal axis, said method comprising:

(a) drilling a first bore in the tool from the first surface along a first drilling axis, said first drilling axis intersecting the first surface at a first oblique angle; and

(b) drilling a second bore in the tool from the second surface along a second drilling axis, said second drilling axis intersecting the second surface at a second oblique angle, said first and second drilling axes oriented such that the first and second bores meet in the tool.

7. The method of Claim 6 wherein the first and second surfaces are substantially parallel to one another.

8. The method of Claim 6 wherein the first bore is larger in diameter than the second bore, and wherein the first and second bores meet at a shoulder in the tool.

9. The method of Claim 6 wherein the first and second drilling axes are substantially co-linear.

10. The method of Claim 6 wherein the first and second oblique angles are substantially equal to one another.

11. The method of Claim 6 further comprising

forming a first seating surface at a point of intersection between the first surface and the first drilling axis prior to (a).

12. The method of Claim 11 further comprising

forming a second seating surface at a point of intersection between the second surface and the second drilling axis prior to (b).

13. The method of Claim 6 wherein drilling operations of (a) and (b) overlap in time.

14. The method of Claim 6 wherein (a) comprises

supporting a first drill with a first drill bushing aligned with the first drilling axis to a position closely adjacent to the first surface.

15. The method of Claim 14 wherein (b) comprises

supporting a second drill with a second drill bushing aligned with the second drilling axis to a position closely adjacent to the second surface.

16. A system for machining a torque-transmitting tool, said tool comprising a shank, an out-of-round drive portion, and a shoulder therebetween, said system comprising:

at least one machine tool; and

a fixture selectively positioned with respect to each machine tool, said fixture comprising at least one sensing element configured to sense the shoulder to register the tool with respect to the fixture and each machine tool.

17. The system of Claim 16 wherein the fixture further comprises an out-of-round opening configured to receive the drive portion

18. A system for machining a diagonal bore in a drive stud of a torque-transmitting tool, said system comprising:

tool comprising a longitudinal axis and first and second surfaces on different sides of the longitudinal axis;

a fixture configured to hold the tool in a selected position;

a first drill oriented with respect to the fixture when in an operative position to drill a first bore in the tool from the first surface along a first drilling axis, said first drilling axis intersecting the first surface at a first oblique angle;

a second drill oriented with respect to the fixture when in an operative position to drill a second bore in the tool from the second surface along a second drilling axis, said second drilling axis intersecting the second surface at a second oblique angle, said first and second drilling axes oriented such that the first and second bores meet in the tool.

19. The system of Claim 18 wherein the first and second surfaces are parallel to one another.

20. The system of Claim 18 wherein the first and second bores meet at a shoulder in the tool.

21. The system of Claim 18 or 20 wherein the first and second drilling axes are substantially co-linear.

22. The system of Claim 21 wherein the first bore is larger in diameter than the second bore.

23. The system of Claim 18 wherein the first and second oblique angles are substantially equal to one another.

24. The system of Claim 18 further comprising:

a first mill oriented with respect to the fixture when in an operative position to form a first seating surface at a point of intersection between the first surface and the first drilling axis.

25. The system of Claim 24 further comprising:

a second mill oriented with respect to the fixture when in an operative position to form a second seating surface at a point of intersection between the second surface and the second drilling axis.

26. The system of Claim 18 wherein the tool comprises a shank and a shoulder between the shank and at least one surface of the drive stud, and wherein the fixture is configured to engage the drive stud and to use the shoulder to register the tool with respect to the fixture and the drills.

27. The system of Claim 18 wherein the fixture comprises a first drill bushing positioned closely adjacent the first surface and aligned with the first drilling axis to support the first drill.

28. The system of Claim 27 wherein the fixture comprises a second drill bushing positioned closely adjacent the second surface and aligned with the second drilling axis to support the second drill.

29. The system of Claim 27 wherein the first drill bushing comprises an oblique end substantially aligned with the first surface.

30. The system of Claim 28, wherein the second drill bushing comprises an oblique end substantially aligned with the second surface.

31. A method for forming a diagonal bore in a torque-transmitting tool comprising a longitudinal axis and first and second surfaces on different sides of the longitudinal axis, said method comprising:

(a) drilling a first bore in the tool from the first surface along a first drilling axis, said first drilling axis intersecting the first surface at a first oblique angle; and

(b) drilling a second, smaller bore in the tool from the first surface along the first drilling axis, said second bore forming with the first bore a step within the tool, said second bore passing through the second surface at a second oblique angle.

32. The method of Claim 31 wherein (a) comprises drilling the first bore in two drilling operations.

33. The method of Claim 32 wherein (a) comprises drilling the first bore with two separate drills in said two drilling operations.

34. The method of Claim 32 or 33 wherein at least part of the second, smaller bore of (b) is drilled between said two drilling operations.

35. The method of Claim 31 wherein (b) comprises drilling the second, smaller bore in two drilling operations.

36. The method of Claim 32 wherein (b) comprises drilling the second smaller bore with two separate drills in said two drilling operations.

37. A method for forming a diagonal bore in a torque-transmitting tool comprising a longitudinal axis and first and second surfaces on different sides of the longitudinal axis, said method comprising:

(a) forming a first part of a first, larger bore in the tool from the first surface along a first drilling axis, said first drilling axis intersecting the first surface at a first oblique angle;

(b) forming a first part of a second, smaller bore in the tool from the first surface along the first drilling axis;

(c) forming a second part of the first, larger bore in the tool from the first surface along the first drilling axis; and

(d) forming a second part of the second, smaller bore in the tool from the first surface along the first drilling axis, said second part of the second, smaller bore passing through the second surface at a second oblique angle.

38. The method of Claim 37 wherein different drills are used in (a) and (c) and different drills are used in (b) and (d).

39. The method of Claim 37 wherein (a) is performed before (c), wherein (b) is performed before (d), and wherein (a) is performed before (d).

ABSTRACT OF THE DISCLOSURE

A torque transmitting tool is machined by registering the torque transmitting tool using a shoulder between the shank and the out-of-round drive portion of the tool as a reference. First and second seating surfaces are milled on first and second opposed surfaces of the tool, and then first and second bores are drilled into the drive stud, starting from the first and second seating surfaces, respectively. The first and second bores intersect within the drive stud to form a stepped diagonal bore in the tool. Alternately, all machining operations are performed from one side of the tool.

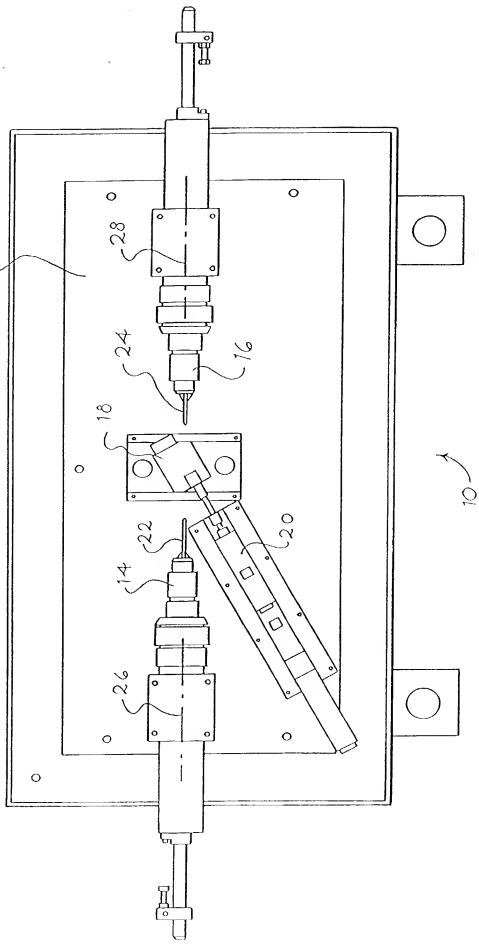


Fig. 1

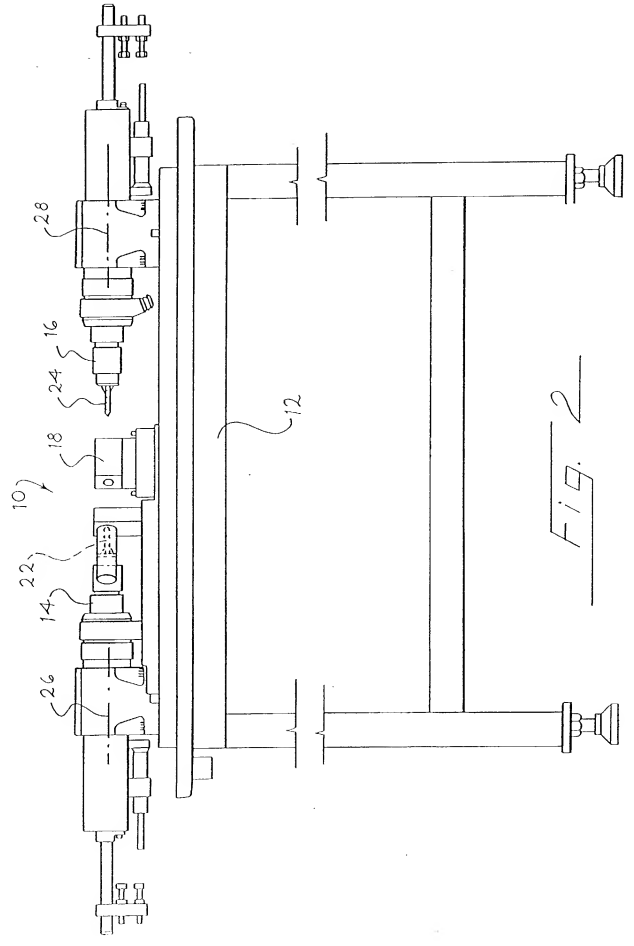
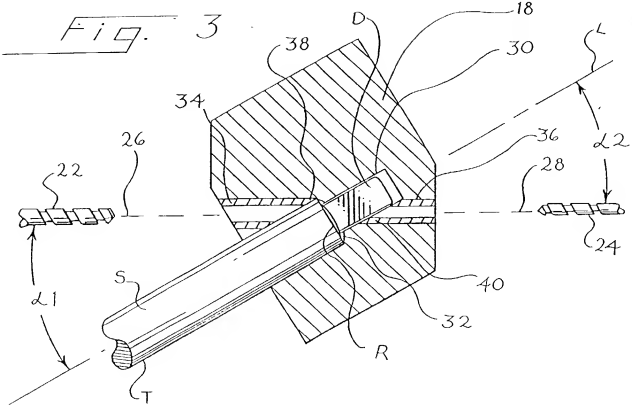


FIG. 2

Fig. 3



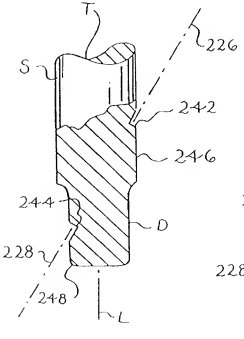


Fig. 6

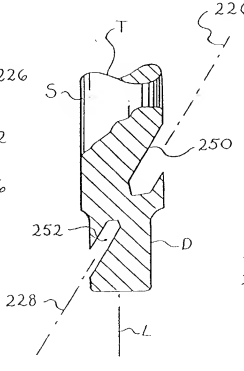


Fig. 7

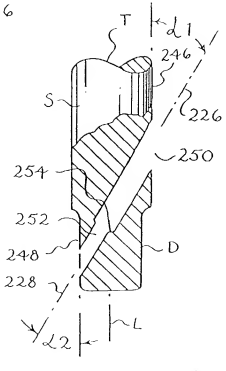


Fig. 8

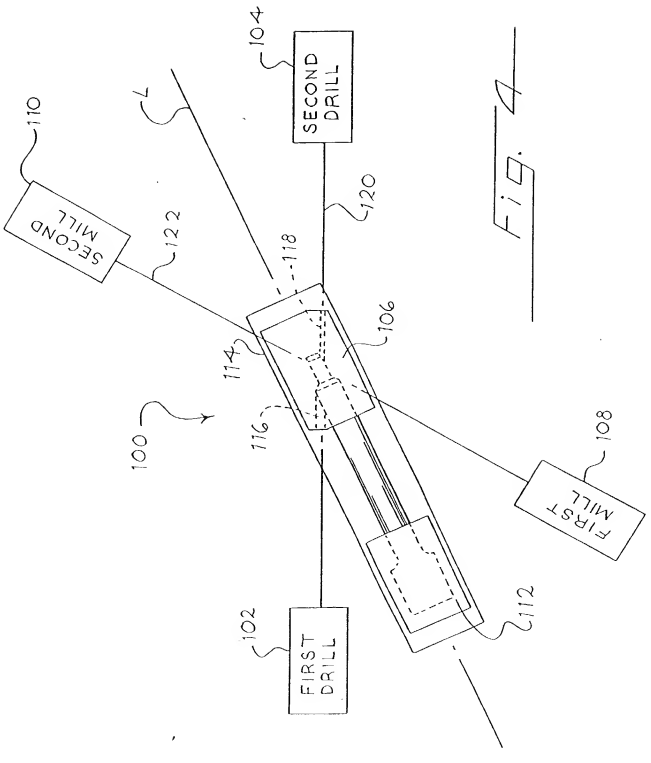


Fig. 4

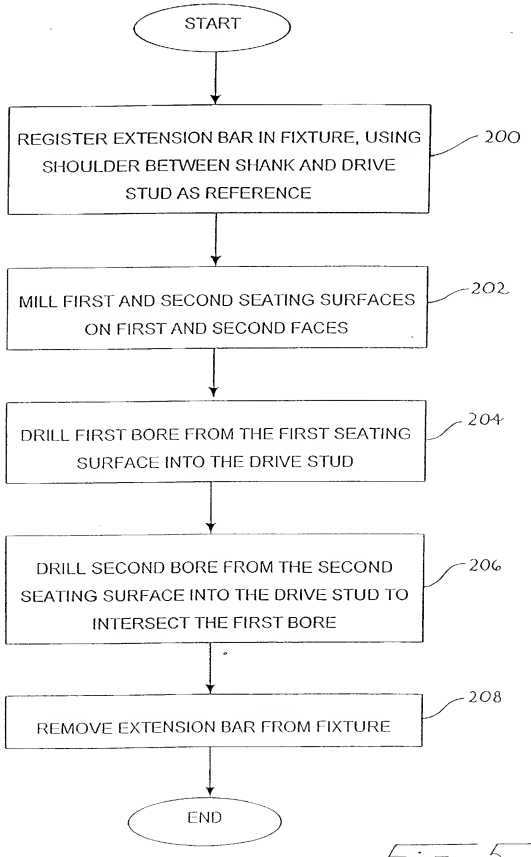

START
REGISTER EXTENSION BAR IN FIXTURE, USING SHOULDER BETWEEN SHANK AND DRIVE STUD AS REFERENCE
200
MILL FIRST AND SECOND SEATING SURFACES ON FIRST AND SECOND FACES
202
DRILL FIRST BORE FROM THE FIRST SEATING SURFACE INTO THE DRIVE STUD
204
DRILL SECOND BORE FROM THE SECOND SEATING SURFACE INTO THE DRIVE STUD TO INTERSECT THE FIRST BORE
206
REMOVE EXTENSION BAR FROM FIXTURE
208
END

Fig. 5

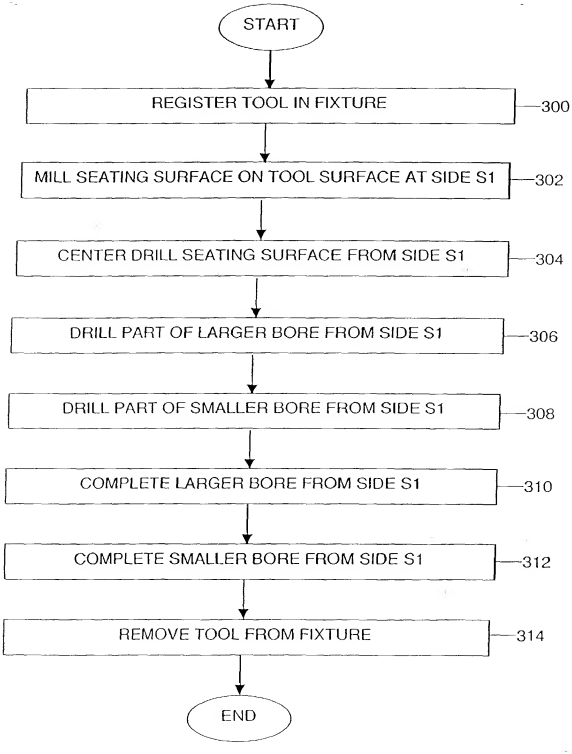


Fig. 9

Case No. 742/226

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD AND APPARATUS FOR REGISTERING A TORQUE-TRANSMITTING TOOL IN A FIXTURE AND FOR FORMING A DIAGONAL BORE IN THE TOOL, the specification of which:

- ☐ is attached hereto.
- ☒ was filed on February 1, 2000 as Application Serial No. 10/089,415.
- ☐ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
			☐ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

60/120,789	February 19, 1999
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/US00/02541	February 1, 2000	Abandoned
(Application Serial No.)	(Filing Date)	(Status-patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Inventor's Signature		Date: 10-7-02
Full name of sole or first inventor	GEORGE F. CHARVAT	
Residence	LOMBARD, ILLINOIS	
Citizenship	UNITED STATES OF AMERICA	
Post Office Address	309 Manor Hill Court, Lombard, Illinois 60148	

BRINKS HOFER GILSON & LIONE
P.O. Box 10395
Chicago, IL 60610
(312) 321-4200

Case No. 742/226

Inventor(s): GEORGE F. CHARVAT

Title: METHOD AND APPARATUS FOR REGISTERING A TORQUE-TRANSMITTING TOOL IN A FIXTURE AND FOR FORMING A DIAGONAL BORE IN THE TOOL

POWER OF ATTORNEY

The specification of the above-identified patent application:

☐ is attached hereto
☒ was filed on February 1, 2000 as application Serial No. 10/089,415

I hereby revoke all previously granted powers of attorney in the above-identified patent application and appoint the following attorneys to prosecute said patent application and to transact all business in the Patent and Trademark Office connected therewith:

Joseph F. Hetz – 41,070

Please address all correspondence and telephone calls to Joseph F. Hetz in care of:

Brinks Hofer Gilson & Lione
P.O. Box 10395
Chicago, IL 60610
(312)321-4200

The undersigned hereby authorizes the U.S. attorneys named herein to accept and follow instructions from JOHN B. DAVIDSON as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by the undersigned.

JODA ENTERPRISES, INC., a CORPORATION, certifies that it is the assignee of the entire right, title and interest in the patent application identified above by virtue of either:

☒ An assignment from the inventor(s) of the patent application identified above, a copy of which is attached hereto.
OR

☐ An assignment from the inventor(s) of the patent application identified above. The assignment was recorded in the Patent and Trademark Office at Reel _____, frame _____.
OR

☐ A chain of title from the inventor(s), of the patent application identified above, to the current assignee as shown below:

1. From _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____, frame _____, or a copy thereof is attached.

2. From _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____, frame _____, or a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

The undersigned has reviewed the assignment or all the documents in the chain of title of the patent application identified above and, to the best of undersigned's knowledge and belief, title is in the assignee identified above.

The undersigned (whose title is supplied below) is empowered to act on behalf of the assignee.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature: John B. Davidson Date: 10-10-02
Name: JOHN B. DAVIDSON
Title: CHIEF EXECUTIVE OFFICER

Rev. Dec -99
C:\Joe\742 - JODA Enterprises, Inc\PTO Filings\742-226 POA.doc